Remarks

Entry of the foregoing amendments and reconsideration of this application is requested. By this amendment, claims 1-5 have been amended to more specifically set forth the invention. Claims 7-20 were previously cancelled. Claims 1-6 are pending in the application.

Claim Rejections

35 U.S.C. § 102and 103

The Examiner has rejected claim 1 under 35 U.S.C. 103(a) as being unpatentable over Xu et al., U.S. Patent No. 5,973,444, hereinafter referred to as Xu. The Examiner in making this rejection states that Xu discloses a method of forming a vacuum microelectronic device comprising: forming at least one electron emitter, a substrate; and applying a first electric field to move a portion of the at least one electron emitter in a direction toward the first electric field. The Examiner acknowledges that Xu fails to teach the step of maintaining the at least one electron emitter in a direction toward the electric field after removing the first electric field. The Examiner states that it would have been obvious matter of design choice to maintain a number of electron emitters in the direction toward the electric field after removing the first electric field since the applicant has not disclosed that this particular step is critical, patentably distinguishing features, and it appears that the

invention would perform equally well with the teaching of electron emitter and its associated with the controlling the application of electric field to the electrode structure as disclosed by the prior art reference.

The applicants respectfully traverse this rejection and state that Xu fails to disclose the applicants inventive method. The applicants assert that Xu fails to disclose the moving of the nanotubes under the influence of an electric field. In contrast to the applicants' disclosure, Xu discloses the moving of electrons under the influence of an electric field. In addition, that applicants assert that the disclosure of Xu fails to provide for a conditioning or first electric field that is of a sufficient strength to provide for the maintaining of the of the at least one electron emitter in a desired direction after removing the conditioning electric field. The Examiner has stated that "it would have been obvious matter of design choice to maintain a number of electron emitters in the direction toward the electric field after removing the first electric field since the applicant has not disclosed that this particular step is critical, patentably distinguishing features, and it appears that the invention would perform equally well with the teaching of electron emitter and its associated with the controlling the application of electric field to the electrode structure as disclosed by the prior art reference".

The applicants adamantly disagree with this statement and assert that the applicants have clearly stated within the originally filed specification that the maintaining of the electron emitters in a particular direction after the removal of the

electric field is of utmost importance so as to provide for the elimination of leakage current and provide for a more efficient device. The applicants assert that the maintaining of the electron emitter in a particular direction after the removal of the electric field is not an obvious matter of design choice, nor was this objective sought to be achieved in the disclosure of Xu. The applicants have stated in the originally filed specification the following: (i) on page 3, lines 12-14 that "the present invention provides for electron emitters which are formed by a novel method that provides high efficiency and low leakage current"; (ii) on page 9, lines 10-19 that "Because at least one of the plurality of electron emitters 13 remains pointing in a direction toward the electric field after the application and removal of the conditioning field, electron emitters 13 emit electrons that generally travel to anode 17 thereby increasing the current density collected by anode 17 for a given value of operating field. The increase current density assists in increasing the efficiency of device 10 compared to a device that was not formed by applying the conditioning field"; and (iii) on page 10, lines 22-33 that "…..it should be appreciated that there has been provided a novel way to form a vacuum microelectronic device. By applying a conditioning voltage between the anode and electron emitters of the device, electron emitters are moved in a direction toward the electric field and remain in such a position after the conditioning field is removed. Moving the electron emitters results in more electrons striking the anode for a given operating electric field value there by increasing the efficiency, and also results in fewer electrons striking the gate electrode thereby reducing the leakage current of the device." The applicants assert that the maintaining of the electron emitter in a specific direction requires a

structural change subsequent to nanotube formation as is achieved by the applicants. The applicants assert that stated by the applicants in the originally filed specification is the disclosure that when the conditioning field is removed, that having the nanotube maintained toward this field keeps the nanotube pointed toward the anode, thereby increasing the collection efficiency by the anode (amounting to less leakage current). The applicants assert that to one skilled in the art that if a nanotube is now preferentially oriented at the anode instead of the gate (with all fields in off), it will take more work (more field) from the gate to point it back toward the gate. Therefore, when a gate field and anode field are applied in operation, there will be more emission towards the anode and less toward the gate than before the application of the conditioning process.

The applicants respectfully point out that Xu fails to make obvious the desire or need to maintain the direction of the electron emitters subsequent to the providing of a conditioning field. Xu fails to provide an initial conditioning field for alignment purposes, prior to the exertion of a second operating, electric field. The applicants assert that this omission of the first conditioning field is not a mere oversight by Xu, nor a simple design choice. The applicants specifically sought a means for producing a more efficient device in which the elimination of leakage current was achieved.

Xu discloses and inventive method for growing field emission cathodes that are fabricated by selectively depositing a catalyst film on a desired area of a

substrate surface, followed by catalytic growth of a carbon-containing fiber emitter structure, as a robust electron emission source. There is no disclosure for the exertion of a conditioning electric field to formed emission structures to achieve the alignment of the electron emitters as described and claimed by the applicants.

The applicants have amended claim 1 to state the step of "applying a conditioning electric field to move a portion of the at least one electron emitter in a direction toward the conditioning electric field, wherein the conditioning electric field is of a sufficient strength to maintain the at least one electron emitter in the direction of the conditioning electric field after removing the conditioning electric field." It is believed that the amendment to claims 1 places the claim in a condition for allowance over the cited Xu reference. In addition, claims 2-5 have been amended to comport with the amendments to claim 1. In that claims 2-6 depend from claim 1, they must contain each and every element of the claim from which they depend and are thus also believed to be in a condition for allowance. Notice to that effect is respectfully requested.

Next, the Examiner has rejected claim 1 under 35 U.S.C. 103 (a) as being unpatentable over Bower et al., U.S. Patent No. 6,630,772, hereinafter referred to as Bower. The Examiner in making this rejection states that Bower discloses a method of forming a vacuum microelectronic device comprising: forming at least one electron emitter, a substrate, applying a first electric field to move a portion of the at least one electron emitter in a direction toward the first electric field. The Examiner

acknowledges that Bower fails to disclose the maintaining of the at least one electron emitter in the direction toward the electric field after removing the first electric field. The Examiner states that this, however, would have been an "obvious matter of design choice to maintain a number of electron emitters in the direction toward the electric field after removing the first electric field since the applicant has not disclosed that this particular step is critical, patentably distinguishing features and it appears that the invention would perform equally well with the teaching of electron emitter and its associated with the controlling the application of electric field to the electrode structure as disclosed by the prior art reference."

The applicants disagree with this statement and as previously stated with respect to the Xu reference, assert that the applicants have clearly stated within the originally filed specification that the maintaining of the electron emitters in a particular direction after the removal of the electric field is of utmost importance so as to provide for the elimination of leakage current and provide for a more efficient device. The applicants assert that the maintaining of the electron emitter in a particular direction after the removal of the electric field is not an obvious matter of design choice, nor was this objective sought to be achieved in the disclosure of Bower. The applicants have stated in the originally filed specification the following: (i) on page 3, lines 12-14 that "the present invention provides for electron emitters which are formed by a novel method that provides high efficiency and low leakage current"; (ii) on page 9, lines 10-19 that "Because at least one of the plurality of electron emitters 13 remains pointing in a direction toward the electric field after the

application and removal of the conditioning field, electron emitters 13 emit electrons that generally travel to anode 17 thereby increasing the current density collected by anode 17 for a given value of operating field. The increase current density assists in increasing the efficiency of device 10 compared to a device that was not formed by applying the conditioning field"; and (iii) on page 10, lines 22-33 that ".....it should be appreciated that there has been provided a novel way to form a vacuum microelectronic device. By applying a conditioning voltage between the anode and electron emitters of the device, electron emitters are moved in a direction toward the electric field and remain in such a position after the conditioning field is removed. Moving the electron emitters results in more electrons striking the anode for a given operating electric field value there by increasing the efficiency, and also results in fewer electrons striking the gate electrode thereby reducing the leakage current of the device."

The applicants respectfully point out that Bower fails to make obvious the desire or need to maintain the direction of the electron emitters subsequent to the providing of a conditioning field. Bower fails to provide an initial conditioning field for alignment purposes, prior to the exertion of a second operating, electric field. The applicants assert that this omission of the first conditioning field is not a mere oversight by Bower, nor a simple design choice. The applicants specifically sought a means for producing a more efficient device in which the elimination of leakage current was achieved.

Bower discloses and inventive field emitter structure and method for forming the structure, namely through the use of a strongly adherent nanotube film. The goal sought to be achieved in Bower is the adherence of powdery or mat-like nanotubes to a substrate, which in the past has proved difficult. Bower describes an in situ method in which during the deposition process for the nanotubes, an electric field is applied. This method is relative only to alignment during the deposition process. Bower does not provide for the re-orienting of the structure subsequent to fabrication. For pre-formed nanotubes, such as those disclosed by the applicants, Bower utilizes an ex situ alignment method in which the nanotubes are located within a polymer matrix that are subject to an uniaxial load above the softening temperature of the matrix, which aligns the nanotubes in the direction of the load. Once the desired level of alignment is attained, the load is released, below the softening temperature, to maintain the structure of the nanotubes. There is no disclosure in Bower for the forming of the nanotubes on the substrate surface, with a subsequent exertion of a conditioning electric field on the pre-formed nanotubes to achieve the alignment of the emitters as described and claimed by the applicants.

The applicants have amended claim 1 to state the step of "applying a conditioning electric field to move a portion of the at least one electron emitter in a direction toward the conditioning electric field, wherein the conditioning electric field is of a sufficient strength to maintain the at least one electron emitter in the direction of the conditioning electric field after removing the conditioning electric field." This step is subsequent to the step of forming at least one emitter on the substrate. It is

believed that the amendment to claims 1 places the claim in a condition for allowance over the cited Bower reference. In addition, claims 2-5 have been amended to comport with the amendments to claim 1. In that claims 2-6 depend from claim 1, they must contain each and every element of the claim from which they depend and are thus also believed to be in a condition for allowance. Notice to that effect is respectfully requested.

The Examiner has next rejected claims 3-5 under 35 U.S.C. 103(a) as being unpatentable over Xu or Bower. The Examiner in making this rejection states that Xu or Bower as modified and relied upon previously, do not teach "using a second electric field having a value that is less than the value of the first electric field " as claimed in claim 3; and the configuration between the second and the first electric field, as claimed in claims 4 and 5. The Examiner asserts it would have been an obvious matter of design choice to choose any desired value for the first electric field and the second electric field since the applicant has not disclosed that the claimed "a second electric field having a value that is less than the value of the first electric field" and the configuration between the second and the first electric field would solve any stated problem or is for any particular purpose and it appears that the invention would perform equally well with the associated electric field configurations as taught by the applied prior art references.

Lastly, the Examiner has rejected claims 2 and 6 under 35 U.S.C. 103(a) as being unpatentable over Xu or Bower, as applied previously, in view of Goren. The

Examiner in making this rejection states that Xu and Bower describe the invention, except for the step of applying the first electric field having a value of at least 0.2-50 V/mA, extracting a current from the at least one electron emitter wherein the electron emitter has an internal current density of at least 1x104A/cm2, as recited in claim 2, and forming at least one nanotube emitter on the substrate, as recited in claim 6. The Examiner asserts that Goren discloses these claimed steps.

The applicants respectfully disagree with these rejections and state that claims 3-6 depend from independent Claim 1. As discussed above in regard to Claim 1, the applicants believe that independent Claim 1 is non-obvious over Xu and Bower. Further, the applicants believe that Claim 1 is non-obvious over any proper combination of the prior art cited by the Examiner. In addition, the applicants respectfully point out that if an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious (See MPEP 2143.03). Therefore, the applicants believe that the 35 U.S.C. 103(a) rejection of Claims 3-6 under Xu, Bower, and Xu or Bower In view of Goren, has been overcome. Accordingly, it is believed that claims 3-6 are also in a condition for allowance. Notice to that effect is respectfully requested.

No amendment made herein was related to the statutory requirements of patentability unless expressly states; rather any amendment not so identified may be considered as directed *inter alia* to clarification of the structure and/or function of the invention and Applicants' best mode for practicing the same. Additionally, no

amendment made herein was presented for the purpose of narrowing the scope of any claim, unless Applicant has argued that such amendment was made to distinguish over a particular reference or combination of references. Furthermore, no election to pursue a particular line of argument was made herein at the expense of precluding or otherwise impeding Applicants from raising alternative lines of argument later during prosecution. Applicants' failure to affirmatively raise specific arguments is not intended to be construed as an admission to any particular point raised by the Examiner.

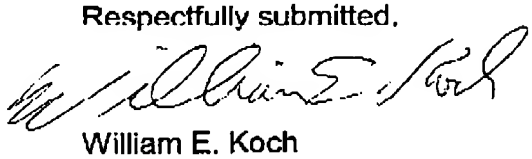
The Applicant believes that the subject application, as amended, is in condition for allowance. Such action is earnestly solicited by the Applicant. In the event that the Examiner deems the present application non-allowable, it is requested that the Examiner telephone the Applicant's attorney or agent at the number indicated below so that the prosecution of the present case may be advanced by the clarification of any continuing rejection.

SUMMARY: Reconsideration is respectfully requested. The applicant believes that claims 1-6 are now in condition for allowance. The applied references do not disclose, teach, or suggest a method of applying a conditioning electric field of sufficient strength to maintain alignment of the emitting electrons subsequent to the removal of the electric field. In fact, the applied references do not disclose, teach, or suggest the application of a conditioning field for this purpose, and the subsequent application of an operating field at all and, therefore, cannot anticipate

or make obvious the present invention. In view of the foregoing amendments and remarks, it is believed that the application, including claims 1-6, is now in condition for allowance. Notice to that effect is respectfully requested.

Applicant respectfully requests a one month extension of time under 37 CFR 1.136(a). The extension fee associated with the action as outlined in 37 1.17(a) is provided in the fee transmittal provided herewith. Authorization is hereby given to charge any fees necessitated by actions taken herein, including the extension of time fees, to Deposit Account 502117.

Respectfully submitted,



William E. Koch
Attorney for Applicant
Reg. No. 29,659
Tel. (602) 952-3628

SEND CORRESPONDENCE TO:

MOTOROLA, INC.
Law Department
Customer Number: 23330